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Single Case

Median Nerve and Ulnar Nerve Entrapment with Cubital Tunnel Syndrome in a Hemodialysis Patient Following Creation of an Arteriovenous Fistula

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Abstract

Neurological and vascular complications associated with creation of arteriovenous access need to be recognized promptly to deliver appropriate interventions for relief of symptoms and avoid loss of function of the involved extremity. We present here a 55-year-old female with end-stage renal disease on hemodialysis secondary to diabetic nephropathy who had a surgical creation of first stage of the brachial artery-basilic vein fistula in the left arm. She subsequently developed pain and weakness of the left arm which was diagnosed as median and ulnar nerve entrapment. She was treated with surgical nerve release and neurolysis and her symptoms improved.

Introduction

Neurological complications of vascular access in maintenance hemodialysis patients have varied etiology and need early detection and intervention [1–6]. Nerve compression and entrapment syndromes such as median, radial, and ulnar nerve entrapment and carpal tunnel syndrome occur more frequently in dialysis patients compared to general population [7–10]. Nerve injury during surgical creation of arteriovenous fistula (AVF), ischemic monomelic neuropathy, and complex regional pain syndrome are complications associated with AVF creation in patients receiving dialysis [11, 12] Brachial artery: basilic vein fistulas are created in many patients in 2 stages with interval of 13 months between the stages to increase maturity rate and reduce complications associated with singe stage creation in patients with

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suboptimum diameter of the basilic vein [13, 14]. We report here a case of nerve entrapment that occurred after creation of brachial artery-basilic vein AVF that was improved by surgical exploration, neurolysis of median nerve in left upper arm, left cubital tunnel release, left carpal tunnel, and left ulnar release. Increased awareness of neurological complications associated with surgical creation of vascular access and early appropriate interventions could prevent many complications associated with creation of arteriovenous access in dialysis patients.

Case Report

We present a 55-year-old female with ESRD on HD secondary to Diabetic nephropathy who presented initially for creation of a hemodialysis access. She had a thirty pack a year history of tobacco use with current use of tobacco products. She had Charcot's disease of the left lower extremity, amputation below knee of her left lower extremity and required use of wheelchair for ambulation. She underwent creation of left basilic vein to the left brachial artery AVF with a plan to perform a second stage superficialization and transposition 6 weeks later. She denied any complaints in the immediate postoperative period. Physical exam during this visit revealed left arm with good grip strength, radial artery pulse of at least 2 , and good thrill in the venous segment of the fistula. She was seen again in the vascular clinic 4 weeks after her surgery with the plan to superficialize her AVF. However, she was now complaining of numbness and mild pain in the left hand which is increased at night. She stated in retrospect that some of these symptoms had started about 4 days after the creation of the fistula. At this point, there was concern for steal syndrome; however, on her exam her hand was pink and warm, and there was still a good radial pulse and a duplex doppler ultrasound revealed good flow in the fistula with no significant reversal of flow and no decreased blood flow in the lower part of the left arm. An electromyogram (EMG) was ordered to evaluate for neurological etiologies to investigate the cause of her left-hand pain. On a subsequent follow-up to the clinic, she was noted to have muscle wasting of the left medial palm and dorsum. Sensation was found to be decreased along the medial aspect of the left arm from the elbow including part of the third, fourth, and fifth digits. Fasciculations were noted in the fingers of the left hand and strength was noted to be reduced. EMG reported a moderate to severe generalized sensorimotor axonal neuropathy in both. A repeat doppler ultrasound of the fistula showed a patent left brachial artery to basilic vein AVF in the left antecubital fossa with partial reversal of flow in the proximal left ulnar artery representing partial steal syndrome. MRI of the left upper extremity showed entrapment of the median nerve (Fig. 1, 2) and cubital tunnel syndrome. A diagnosis of nerve compression syndrome was made and patient was scheduled for surgical exploration. At surgery, she was found to have extensive scarring leading to median nerve compression in the upper arm adjacent to the brachial artery-basilic vein AVF. There was evidence of ulnar neuropathy in the cubital tunnel with hourglass deformation of the ulnar nerve without significant subluxation, and there was also evidence of median neuropathy at the wrist with hourglass deformation of the median nerve in the carpal tunnel. She had exploration and neurolysis of median nerve in left upper arm, left cubital tunnel release with anterior subcutaneous transposition, left carpal tunnel, and left ulnar release. The fistula was also superficialized, retunneled, reanastomozed to the above elbow brachial artery. Following this surgery, our patient reported her pain in the left arm had improved but did not resolve completely. Her fasciculations however improved significantly. Hemodialysis was started successfully 8 weeks later utilizing the left brachial artery-basilic vein fistula. In subsequent months after surgery, her pain in the left arm and left arm muscle weakness significantly improved.

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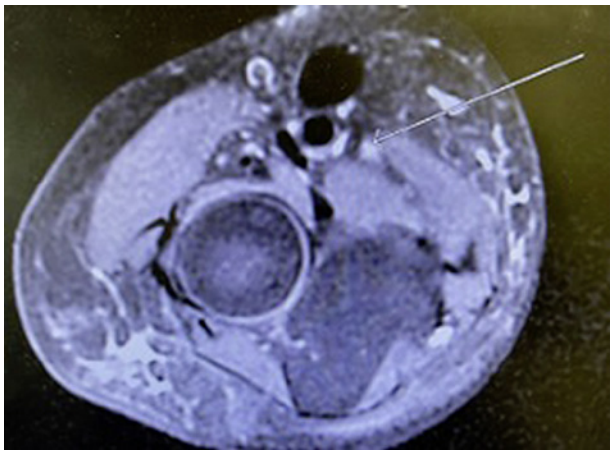

Fig. 1. Magnetic resonance imaging of the upper arm with the brachial artery-basilic vein AVF shows edema of (long arrow) of the median nerve adjacent to the brachial artery and the basilic vein. AVF, arteriovenous fistula.

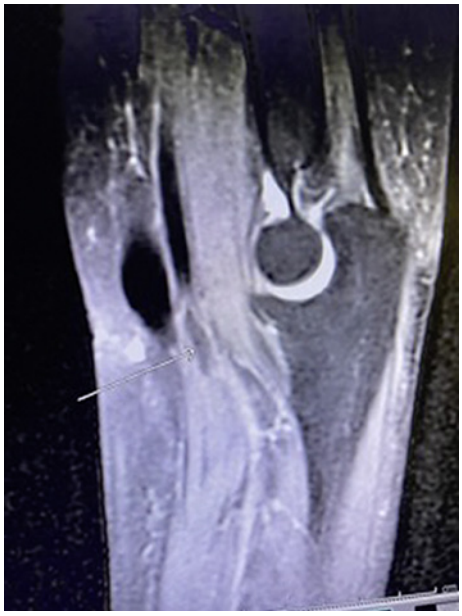

Fig. 2. Magnetic resonance imaging of the upper arm with the brachial artery-basilic vein AVF shows compression and swelling of the median nerve (arrow) in this patient by the brachial artery and the basilic vein. AVF, arteriovenous fistula.

Discussion

Multiple etiologies need to be considered to plan the appropriate and expedited management strategy (Table 1) in a patient who has symptoms such as hand pain or muscle weakness or sensory loss in the ipsilateral arm of the AVF following surgical creation [2, 15]. The etiology is varied and knowledge of the anatomy of the vascular and nerve supply is key to diagnose and intervene to prevent complications. The median nerve, derived from the lateral root of the lateral cord and the medial root of the medial cord of the brachial plexus, does not have any branches until it enters the forearm, where it lies medial to the brachial artery in the cubital fossa. This proximity to the brachial artery places the median nerve under risk of compression if there is development of brachial artery (pseudo)aneurysm or a hematoma due to bleeding. Entrapment of the median nerve may result in weakness and diminished strength movements including wrist flexion, pronation, and fine movements of the hand, which can impact greatly on the patient's functional abilities. Sensory loss predisposes to injury. The entrapment of the ulnar nerve in the cubital fossa is a phenomenon similar to median nerve entrapment at the wrist (carpal tunnel syndrome) and has been

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Table 1. Common causes of upper extremity pain and/or wasting in hemodialysis patients

Etiology	Mechanism/cause of the underlying injury	Management strategy
Primary nerve injury		
Uremic and diabetic neuropathy	Demyelination of especially large nerve fibers which usually start distally and progress proximally	Effective dialysis dose delivery and ultrafiltration to remove uremic molecules. Maintain normokalemia renal transplantation is found to be helpful
Nerve compression syndromes	Compression of the nerve due to edema or fibrosis or impinging of the nerve by the neighboring vessel(s)	Surgical exploration with neurolysis and tunnel release with relief of pressure from fibrosis, edema, hematoma, and surrounding structures
Nerve injury during surgical creation of vascular access	Manipulation and or transection of the nerve during surgical creation of the fistula. Hematoma during surgery compressing the adjacent nerve	Evacuation of the hematoma if it is the cause of nerve compression Aneurysm repair if aneurysm is impinging the nerve
Carpal tunnel syndrome	Compression of the medial nerve in many dialysis patients due to accumulation of beta-2 microglobulin amyloidosis	Surgical release of the median nerve or supportive management such as wrist splints
Reflex sympathetic dystrophy	Possibly peripheral ischemia	Sympathetic or ganglion block, physiotherapy, and analgesics are frequently unsuccessful. Ligation of the access is also frequently unsuccessful
Primary vascular cause of hand pain		
Distal hypoperfusion ischemic syndrome	Reduced blood flow to the distal hand due to obstructive atherosclerotic arterial disease	Endovascular interventions or surgery to increase distal hand blood flow
Ischemic monomelic neuropathy	Vascular insufficiency causing injury of the nerve due to infarction of the vasa nervorum	Ligation of the fistula as steals is associated etiology in many cases DRILor proximalization of the arterial inflow
Steal syndrome	Reduced blood flow to the distal hand due to high inflow into the fistula proximally	Endovascular interventions or surgery such as banding to increase distal hand blood flow

DRIL, distal revascularization with interval ligation.

labeled as the cubital tunnel syndrome [16, 17]. The median nerve is also vulnerable at this site. Ulnar nerve compression in the tunnel at wrist is called Guyon's syndrome [18]. Carpal tunnel syndrome which is due to entrapment and compression of the median nerve is the most common nerve compression syndrome in dialysis patients occurring in as much as 50% of patients after 10 years of hemodialysis [19]. It is more frequently seen than the general population and has been reported to occur with equal frequency in the ram contralateral to the access for hemodialysis [20, 21].

In our patient, the fistula that created was a basilic vein-brachial artery AVF. Basilic vein is the largest of the veins in the upper extremity and requires extensive dissection to mobilize

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the vein for its anastomosis of the brachial artery which makes it particularly vulnerable for injury of the vein itself and the median nerve [13].

We did not think she had ischemic monomelic neuropathy as it usually presents with severe pain in the immediate postoperative period [12, 22–24]. Table 1 summarizes the differential diagnosis that needs to be considered in a patient who presents with pain or weakness in the arm following surgical creation of an AVF or placement of an arteriovenous graft. Our patient had gradual onset of hand pain, paresthesia, and predominant muscle weakness of her left arm which suggested a gradual compression syndrome of the medial and ulnar nerve. This also distinguished it from distal hypoperfusion ischemic syndrome as there was no difference in temperature between the arms, absence of digital ulcers and had fairly good radial artery pulsation [25]. Along with good flow in the vessels on doppler ultrasound of the vessels. EMG in our patient showed bilateral severe generalized sensorimotor axonal neuropathy in the upper extremities but her symptoms were only in the ipsilateral arm of the fistula. Retrospectively, this EMG finding misled us leading to delay in surgical intervention. Similar to our patient a complete or partial relief has been reported in 10 patients who had surgical intervention for upper extremity nerve compression related to arteriovenous hemodialysis access [15].

In conclusion, we report a case of median nerve and ulnar nerve compression syndrome along with cubital tunnel syndrome following creation of the basilic vein-brachial artery AVF which was managed with surgical neurolysis of the median nerve and cubital, carpal tunnel, and nerve release. This case illustrates the point of consideration of multiple etiologies, close follow-up and timely intervention of patients for complications associated with creation of arteriovenous access in dialysis patients. We suggest evaluation for carpal tunnel syndrome prior to AVF surgery and even nerve conduction studies in patient with diabetes mellitus prior to surgical creation of the AVF. Monitoring of blood flow in the fistula to monitor for steal phenomenon will also be valuable in these patients. In cases where surgical release of the nerve is done histological analysis of the material impinging on the nerve and staining of beta-2-microglobulin amyloidosis may be considered. Monitoring for signs and symptoms of nerve entrapment due to nerve impingement should be done routinely, and this is particularly important in patients who already have evidence of pre-existing evidence of deficits in nerve conduction studies prior to surgical creation of AVF.

Statement of Ethics

The family of the patients gave written informed consent for publication of the cases including publication of images. This case study was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. This paper is exempt from Ethics Committee approval as we obtained consent from the patient described to publish this case report and Lundquist IRB at Harbor-UCLA Medical center does not require Ethics Committee approval.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

R. Dukkipati and A. Shah wrote the manuscript and revised the manuscript. A. Shah, A. Richler, and C. de Virgilio contributed to patient care.

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